विद्युत सुरक्षा व विद्युत संच मांडणी रचना / आराखडा प्रमाणपत्र अभ्यासक्रमास मान्यता देण्याबाबत.

महाराष्ट्र शासन
उद्योग, ऊर्जा व कामगार विभाग
शासन निर्णय क्रमांक : संकिर्ण-२०१६/प्र.क्र. १२४ /ऊर्जा-५
मादाम कामा रोड, हुतात्मा राजगुरु चौक, मंत्रालय, मुंबई ४०० ०३२.
दिनांक : ०६ एप्रिल, २०१६.

संदर्भ : १. उद्योग व कामगार विभाग, शासन निर्णय क्र.IER.१०६२-Elec दि.१५ मार्च,१९६२.
२. मुख्य विद्युत निरीक्षक, मुंबई यांचे पत्र क्र.मुविनिमुं/कक्ष-१/४४६/२०१६ दि.१४.०३.२०१६

प्रस्तावना:

केंद्रिय विद्युत प्राधिकरण (सुरक्षा व विद्युत संबंधी उपाययोजना) विनियम २०१०, दिनांक २० सप्टेंबर, २०१० पासून लागू करण्यात आले आहेत. यातील विनियम क्र. २९ नुसार राज्य शासनास विहित अर्हता प्राप्त व्यक्तीस विद्युत पर्यवेक्षक म्हणून योग्यता प्रमाणपत्र देण्याचे अधिकार आहेत. उद्योग व कामगार विभागामार्फत दिनांक १५ मार्च, १९६२ अन्वये अधिसूचित करण्यात आलेल्या नियमावलीतील नियम क्र.१४ (१) नुसार विद्युत अभियांत्रिकी मध्ये पदवी अथवा पदविकाधारक अभियंत्यांना विद्युत पर्यवेक्षक क्षमता प्रमाणपत्रासाठी एक वर्षाचा विद्युत अभियांत्रिकी क्षेत्रामधील प्रत्यक्ष कामाचा अनुभव अनिवार्य आहे. बेरोजगार विद्युत अभियंत्यांना स्वयंरोजगार करण्यासाठी सुकर व्हावे याकरिता विद्युत पर्यवेक्षक प्रमाणपत्र मिळविण्यासाठी सध्याची एक वर्षाची अनुभवाची अट शिथिल करण्याची बाब शासनाच्या विचाराधीन होती. सदर अनुभवाच्या अटीस पर्याय म्हणून याबाबत एक अल्प मुदतीचा प्रात्यक्षिक प्रशिक्षणासह अभ्यासक्रम तयार करण्यासाठी व्हीजेटीआय, मुंबई या अग्रगण्य अभियांत्रिकी महाविद्यालयाच्या विद्युत विभागाचे प्रमुख यांच्या अध्यक्षतेखाली एक समिती गठित करण्यात आली होती. या समितीमध्ये महावितरण कंपनी, टाटा पॉवर कंपनी, रिलायन्स एनर्जी, ईलेक्ट्रीकल कॉन्ट्रक्टर असोसिएशनचे प्रतिनिधी व विद्युत निरिक्षक, मुंबई हे सदस्य होते. समितीने सखोल चर्चा करुन १२ आठवडयांचा विद्युत सुरक्षा व विद्युत संच मांडणी रचना/आराखडा प्रमाणपत्र अभ्यासक्रम (Certificate Course on Electrical Safety and Design Aspects of Electrical Installation) तयार केला असून तो मुख्य विद्युत निरिक्षक, मुंबई यांनी संदर्भ क्र.२ अन्वये शासनास मान्यतेसाठी सादर केला आहे.

शासन निर्णय :

विद्युत सुरक्षा व विद्युत संच मांडणी रचना/आराखडा प्रमाणपत्र अभ्यासक्रमास या शासन निर्णयाव्दारे मान्यता देण्यात येत आहे. सदर अभ्यासक्रमाचा तपशील या शासन निर्णयासोबत परिशिष्टामध्ये जोडला आहे.

२. सदर अभ्यासक्रमानुसार द्यावयाचे प्रशिक्षण महावितरण, महापारेषण, महाजेनको, टाटा पॉवर कंपनी, बेस्ट, रिलायन्स एनर्जी लि. या कंपन्यांनी त्यांच्या प्रशिक्षण केंद्रात द्यावे व यशस्वीरित्या प्रशिक्षण पूर्ण केलेल्या अभियंत्यांना संबंधित संस्थेने प्रमाणपत्र द्यावे.

३. विद्युत सुरक्षा व विद्युत संच मांडणी रचना/आराखडा प्रमाणपत्र अभ्यासक्रम यशस्वीरित्या पूर्ण केलेल्या अभियंत्यांना **"विद्युत पर्यवेक्षक क्षमता प्रमाणपत्र"** विद्युत निरिक्षणालय शाखे मार्फत देण्यात येईल. त्याकरिता त्यांनी संबंधित जिल्हयाच्या विद्युत निरीक्षकाकडे विहित कार्यपध्दतीनुसार अर्ज सादर करावा.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करण्यात आला असून त्याचा सांकेतांक २०१६०४०६१८२५३२१७१० असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकीत करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नांवाने,

Bhimashankar Yallapa Manta

Digitally signed by Bhimashankar Yallapa Manta
DN: c=IN, o=Government Of Maharashtra, ou=Deputy Secretary, postalCode=400051, st=Maharashtra, cn=Bhimashankar Yallapa Manta
Date: 2016.04.06 18:25:07 +05'30'

(भि.य.मंता)
शासनाचे उपसचिव

प्रत-

१) मा.राज्यपाल यांचे प्रधान सचिव
२) मा. मुख्यमंत्री यांचे प्रधान सचिव,मंत्रालय, मुंबई ३२.
३) मा. मंत्री (ऊर्जा) यांचे खाजगी सचिव, मंत्रालय, मुंबई ३२.
४) मा. विरोधी पक्ष नेता, विधानसभा/विधानपरिषद,विधानमंडळ सचिवालय,विधानभवन, मुंबई.
५) व्यवस्थापकीय संचालक, महाराष्ट्र राज्य वीज वितरण कंपनी, प्रकाशगड, बांद्रा (पूर्व), मुंबई-५१
६) व्यवस्थापकीय संचालक, महाराष्ट्र राज्य वीज पारेषण कंपनी, प्रकाशगंगा, बांद्रा (पूर्व), मुंबई-५१
७) व्यवस्थापकीय संचालक, महाराष्ट्र राज्य वीज निर्मिती कंपनी, प्रकाशगड, बांद्रा (पूर्व), मुंबई-५१
८) व्यवस्थापकीय संचालक, टाटा पॉवर कंपनी लि. बॉम्बे हाऊस, २४ होमी मोदी स्ट्रीट, मुंबई-०१
९) व्यवस्थापकीय संचालक, बृहन्मुबई वीज पुरवठा व परिवहन उपक्रम(बेस्ट), मुंबई-०५
१०) व्यवस्थापकीय संचालक, रिलायन्स इन्फ्रास्ट्रक्चर, अंधेरी (पूर्व), मुंबई-९३.
११) सर्व मंत्रालयीन विभाग.
१२) मुख्य विद्युत निरिक्षक, उद्योग, ऊर्जा व कामगार विभाग, मुंबई.
१३) विद्युत निरिक्षक (सचिव, अनुज्ञापक व उद्वाहन निरीक्षक), उद्योग, ऊर्जा व कामगार विभाग, मुंबई.
१४) सचिव, इलेक्ट्रीकल कॉन्ट्रॅक्टर असोसिएशन ऑफ महाराष्ट्र, मुंबई.
१५) मुख्य अभियंता, सर्व परिमंडळ, महावितरण / महापारेषण / महानिर्मिती.
१६) कक्ष अधिकारी (प्रशासन-२), उद्योग,ऊर्जा व कामगार विभाग, मंत्रालय, मुंबई.
१७) निवड नस्ती (ऊर्जा-५), उद्योग,ऊर्जा व कामगार विभाग, मंत्रालय, मुंबई.
१८) ऊर्जा विभागातील सर्व कार्यासने.

परिशिष्ट

शासन निर्णय, उद्योग, ऊर्जा व कामगार विभाग
क्रमांक : संकिर्ण-२०१६ / प्र.क्र. १२४ / ऊर्जा-५
दिनांक : ०६ एप्रिल, २०१६ चे सहपत्र

Syllabus for Certificate course on Electrical Safety & Design Aspects of Electrical Installation

Duration : 12 weeks.

Scheme:

Week	No. of Days	Activity
Week 1	5	Class room training
Week 2	5	Class room training
Week 3, 4, 5, 6	20	Practical on the field
Week 7	5	Class room training
Week 8, 9, 10, 11	20	Practical on the field
Week 12	5	Class room training

Course Outcome:

1) Refreshment of the knowledge studied during diploma/graduation.

2) Candidate will be able to understand SLD and design the ratings of electrical components for given system.

3) Candidate should be able to repair, install and maintain different electrical equipments like transformer, motors, battery, transmission lines, cables etc.

4) Candidate will be able to work independently as an electrical supervisor/contractor.

5) Candidate will have knowledge of EA-2003 and familiarity to modern trends used in electrical power system.

Detailed syllabus:

***Week 1*:**

Principles of Electricity : Current, Voltage and Resistance, Ohms law and Kirchhoff's law, its application, Specific Resistance, Laws of Resistance and their application for calculating voltage drop, Series and Parallel Circuit, Single phase and Three phase Power and energy, Relationship between electrical power unit (kW) and mechanical power unit (H.P.).

Materials - Conductors, non conductors and insulators, Insulating materials and their relative merits, Transformer oil. Properties of transformer oil, Effects of heat and moisture on insulation, Insulation resistance.

Different types of wires, cables, switches, HV and LV Circuit breakers, cut outs, Fuses, Feeder Piller, Distribution board etc., and their safe current carrying capacity, Use of tables and data sheets generally given in electrical hand books.

Batteries - Primary cells, Dry cells, Storage or secondary batteries or accumulators and their installation. Lead acid cells, Nickel iron or alkaline cells. Initial and subsequent charging of batteries, Charging circuits and their calculations, Series and parallel circuits, Maintenance of batteries, Use of hydrometers.

A.C. Circuits - Knowledge of vectors, Phase and phase difference, Resistance, Inductance and Capacitance in an A.C. circuit, Concept of Impedance, Power, reactive power and apparent power, Concept of power factor and its importance, Single phase and three phase system, Star and delta connections, Concept of phase sequence, Concept of Demand, Interpretation of common terminology e.g. kVA, kW, kVAR and kWh, AC and DC circuits, Concept of Phase, Neutral and Earth Conductors, Use of tables and data sheets generally given in electrical hand books.

A.C. Motors - Theory of Induction (squirrel cage and slip ring type) synchronous and commutated motors, their uses. Installation, method of starting and speed control, Reversal of direction of rotation.

D.C. Motors - Theory of series, shunt and compound wound type motors, their uses, Installation, method of starting and speed control, Reversal of direction of rotation.

Contactors and starters, regulators, protective devices for both A.C. and D.C. motors, their wiring with the motors.

Transformers : Knowledge of single phase and three phase transformers, principle of operation, constructional features and uses. Types of cooling and maintenance. Paralleling of transformers. Auto transformers and its uses. Transformer tappings, temperature rise. Instrument transformers and its uses. Operation and Maintenance.

Earthing : Principles of different methods of earthing, Importance of earthing, Factors affecting earth resistivity, Earth resistance measurement, Earthing systems, Methods of earhing, Earthing Grid.

Energy Meter: Working principle of Electromechanical and Static meter, Main features of Electro-mechanical Meter, Functioning of Static Energy meter and its main features, Single Phase Meter, installation standards and its wiring, Whole current three phase meter installation and wiring. Overview of CT and PT and its function. LT meter, CT operated installation and wiring. HT meter installation and wiring. Metering deficiency and tampering, Effect due to incorrect connection, fiddle condition, common neutral problem, Meter Reading, recording and sealing, Understanding to read Monthly Power Bill and complaint resolution, Emerging technologies in metering Meter Replacement procedure, Meter testing Applicable regulations on metering and billing.

***Week 2*:**

Distribution Lines: Simple calculations on current capacity of various loads for distribution of power. General principles of construction of low, and high voltage lines.

Types of conductors, sizes and current capacities, Length of spans, sags, strength of poles, spacing of conductors and cross arms, effect of temperature, wind pressure, ice and snow on the lines, Tension on wire, Insulators, brackets, stays, struts, guard wires and other protective devices, Earthing arrangement and Lightening Arrester, Testing and fault location, Use and jointing of different types of aluminium conductors. Stringing of conductors.

<u>Switch Gear and Circuit Breaker</u>: Fuses, MCB, RCCB, ELCB, DP Switches Introduction to circuit breaker fundamentals. Arc phenomenon and methods of arc extinction, Characteristics of arc quenching mediums, Classification and types of circuit breakers (OCB, MOCB, ABCB, VCB, SF6), constructional features, Selection parameters, ratings, specifications, interlocks, Operating mechanism, Breaker control circuit, Best practices of operation and maintenance on EHV, HV and LV circuit breakers (ABB, CGL, Siemens, Schinder etc.).

<u>Introduction to Cables</u>: Understand what is a cable, classification of cables, components and its function, Overview of Construction of cables, Types, size and capacities of cables, Uses and application of cables.

<u>Testing and maintenance of Equipments:</u>

- Type Tests and routine tests.
- Testing of Transformers for continuity and IR value.
- Transformer outage safety practices -Importance of accurate SLD. Isolation, LOTO, PTW. Testing with neon tester, discharging the windings and grounding. JSA and Tool Box talk.
- Operation and Maintenance of Transformer : Transformer loading, temperature limit, Condition monitoring, inspection, maintenance schedule and Maintenance checks. Understanding of Cooling Fans control circuit.
- Case studies on Trouble shooting and Transformer failures.
- Attending oil leakages, replacement of gaskets, untanking and inspection.
- Testing and maintenance of circuit breaker: Electrical controls & alarms / lockouts.
- Testing of and maintenance of Bus Bars: Layout arrangement (indoor & outdoor). Bus bar types, construction, support insulators, jumpers, safety clearances, connection to bus, design, selection parameters, ratings, specifications, interlocks. Isolator: Types, constructional features, Earth switch, interlocks, design, selection, rating, specifications. Double bus bar system & Changeover system & its design
- Testing and maintenance of CT/PT/CVT/LA: Constructional features, testing and application. RMU and Drives
- HV and LV Cable Jointing Preparation : Tools for cable jointing and selection of suitable Cable jointing kit. Understanding and interpretation of cable jointing drawing supplied by OEM. LV Cable jointing: Understanding the LV/HV cable jointing procedure. LV/HV Cable Termination: Understanding LV cable termination procedure.

Week 7:

- Overview of field training and feed back from candidates
- Power factor improvement methods:
- Importance of maintaining power factor, Methods of PF improvement, Selection of capacitor size, ratings etc. Introduction to Concept of facts.
- Introduction to static relay and their connections.
- Introduction to EA - 2003
- CEA (Measures relating to safety & elect supply) 2010
- Code of practice for cinema & lift and escalators installation.

SCADA Sytem

Concept of SCADA, Application of SCADA, Various equipments used for control and its installation, Various equipments used for data acquisition and its installation

Energy Audit & Conservation

Concept of EA, Application of EA, Tagging of customers up to last mile. Loss calculation, Loss mitigation techniques (technical, commercial).

TEST and suggestions for improvement in the next phase of training.

Week 12:

- Overview of field training and feed back from candidates.
- Selection of equipments:
- Breakers / protective gears (OCB/ACB/MCCB/MCB/HRC fuses & its utilization category on the basis of its application.
- Computation of fault level & making & breaking capacity of protective gear.
- Protection coordination, Insulation coordination.
- Computation of continuous & short circuit rating of Cable.
- Computation of de rating capacity of cable considering various de rating factors.
- Selection of Different types of Motors for specific applications.
- Methods of connection of special types of transformer (Furnace transformer/welding transformer/rectifier transformer etc.).
- Captive generation, its design considering capacity & load.
- Introduction to costing of different electrical installations.
- Final TEST/ Viva and suggestions for improvement.
- Feedback regarding the course.

Different Practicals observations and activities to be carry out during field visit

- Installation of MCB/ELCB/RCCB/Cut out.
- Wiring (Use of flexible/Stranded wires, connectors, Clipping, Conducting, saddling, crimping lug etc.).
- Wiring for inverter circuits.
- Clipping / Clamping.
- Termination (Making gland, Crimping etc.).
- Installation of inverter.
- Installation of lighting fixtures.
- Meggar of wiring & other installation.
- Installation of Bus duct /Rising mains/Tap of box.
- Installation of Bus trunking.
- Installation of SFU/SDF.
- Installation of energy meters..
- Methods of Earthing.
- Measurement of Earthing.
- Load Survey.
- Computation of cable size & wiring.
- Computation of voltage drop & its permissible limits.
- Deciding the transformer capacity.
- Design of mains switch board.
- Design of sub switch board & distribution board.
- Preparation of lay out of all installation considering the safety /operational clearances and space optimization.
- Preparation of single line diagram & other drawings of electrical installations as per standards.
- Getting approval of layout from the respective authorities.
- Installation of electrical equipments as per the statutory requirements.
- Installation of solar panel , inverter etc & related accessories.
- Installation of CT metering.
- Installation of SDF, Distribution boards etc.
- Installation of ICOG panels.
- Termination of cables at DT (HV/LV).
- Pre commissioning test of all equipments.
- Post commissioning test of all equipments.
- HV testing, Megger etc.
- Installation of Capacitors/APFC.
- Installation of energy meter for energy audit.
- Installation of distribution panel.
- Type of material used for earth bus bar.
- Computation of size of earth busbar considering current density, Touch potential & step potential, corrosion factors ,soil type etc.

- Computation of Types of earth electrodes (Plate/pipe/strip etc.) and its size for different equipments.
- Measurement of soil resistivity.
- Measurement of earth resistance using 3-point method / clamp type earth resistance meter.
- Different types of material used to enhance the earth resistance.
- Different type of methods used to enhance the earth resistance.
- Maintenance of earthing.
- Knowledge of IS 3043 & CEA regulations for earthing.
- types of starting methods for AC/DC motors.
- types of speed control of AC/DC motors.
- Protection used for AC/DC motors Transformers.
- types of capacitors used for pf improvement
- methods of pf improvement.
- Methods of connection of special types of transformer (Furnace transformer/ welding transformer /rectifier transformer etc.).
- Different types of measuring instruments to measure power.
- Trivector meters.
- Installation of energy meters.
- TOD metering.
- Difference between conventional & electronic energy meters.
- Category of consumers on the basis of its load Computation of cost of electricity.
- Cable identification.
- Cable route tracing.
- Physical Inspection of electrical installation.
- Laying of cable.
- Termination of cable in switchgear / panel.
- Installation of overhead line.
- Connection of DG set.
- Installation of lightening arresters.
- Termination of cables in HT/LT switchgears.
- Termination of cable at Transformer.
- Installation of transformer.
- Installation of Switch gear.
- Information of relevant IS/CEA regulation.
- Insulation test (megger) of equipments.
- Earth resistance measurement of equipments.
- HT/LT fault testing (using different types of test methods viz. pulse echo, arm plus, low frequency etc).
- Application of DC surge (its value)for testing on cable fault.
- Fault pinpointing.
- Identification of fault on installation in case of earth leakage.
- LIVE phasing .
- Polarity testing.
- Primary injection testing.

- Secondary injection system.
- BV testing of oil.
- Testing of 1ph & 3 ph meter.
- Relay testing.
- Magnetic balance test.
- Testing of switchgear operations.
- Earth continuity testing.
- Testing of measuring instruments like energy meters, ammeters, voltmeters etc.
- Load reading of cable at terminations.
- Load balancing.
- Attending abnormalities of distribution box.
- Maintenance of Overhead line.
- Rectification of faults.
- Maintenance of lightening arresters.
- Different types of joints (heat shrink/cold shrink etc.).
- Through phasing in case underground cable joint.
- Importance of each component of joint kit.
- Safeguarding of joint on underground cable.
- Jointing of overhead conductor.
- Safety precautions while jointing.
- Relevant IS / CEA regulations.
- Statutory requirement for clearance from LIVE part from ground, adjacent. equipment, buildings, sections
- Clearance of switchboards, other equipments.
- Clearances in indoor equipment.
- Clearances in outdoor equipment.
- List of symbols as per NES.
- IEE standards for electrical symbols.
- Preparation & reading of simple electric wiring diagram & circuit diagram.
- Electrical connections diagram for AC/DC generators, starters, regulators etc.
- Electrical connections diagram for battery charging equipments
- Electrical connections diagram lift & safety devices
- Electrical connections diagram for battery charging equipments.

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